necessary energy, under optimum conditions, at least 100 pounds of carbohydrate for every pound of nitrate formed.[21] Under no conceivable conditions could the algal flora of a soil supply any substantial portion of the 250 tons of dextrose needed for such fixation.

The most recent contribution to the subject is a study of the nitrate content of the country rock by STEWART and PETERSON.[22] While working primarily in Utah, these authors have collected and analyzed large numbers of sandstones, limestones, and shales from widely separated localities throughout Utah, Wyoming, and Colorado. These may be considered fairly representative of the country rocks occurring in the area covered by the cretaceous and tertiary seas. They find that while the Jurassic sandstones and shales are not characterized by an unusually high nitrate content, the cretaceous and tertiary sandstones everywhere contain nitrates far in excess of the quantities present in ordinary alkali-free soils, often to the amount of one to ten tons per acre-foot; while the tertiary shales have prevailingly an even higher nitrate content. Over very extensive, wholly barren areas of virgin "clay hill" soil there is present beneath the compact, impermeable surface clay a layer of ash-like material, two to six inches in thickness, bearing 0.15 to 0.20 per cent of sodium nitrate, an amount equal to 900 to 36,000 pounds per acre-foot. The authors estimate the total nitrate content of the Book Cliffs area in Utah and Colorado as being many times greater than that of the deposits of Chile, but have nowhere found concentrations of such extent and character as would permit them to be profitably worked, a situation resembling that found by FREE[23] in southern California. STEWART and PETERSON consider that the discovery that nitrate deposits are not confined to the shales, but are generally present in the country rock, and that their amounts are everywhere materially greater than has been hitherto supposed, constitutes conclusive proof that "niter spots" are accumulations resulting from leaching, and have no relation to bacterial activities in the soil. In view of the very large accumulation of evidence against the latter hypothesis and the conclusive character of the results obtained by STEWART and his co-workers, this conclusion would appear to be wholly justified.—JOSEPH S. CALDWELL.

Some temperature effects.—In discussing some of the phytogeographic effects of winter temperature, SHREVE[24] calls attention not only to the great lack of critical data, but more especially to the fundamental error, so prevalent

[21] MARSHALL, C. E., Microbiology. Philadelphia: Blakiston & Co. 1912. pp. 272–273.

[22] STEWART, ROBERT, and PETERSON, WILLIAM, The nitric nitrogen content of the country rock. Bull. Utah Agric. Exper. Sta. no. 134. pp. 420–465. 1914.

[23] FREE, E. E., Nitrate prospects in the Amargosa valley, near Tecopa, Cal. Circular U.S. Dept. Agric., Bur. Soils. no. 73. 1912.

[24] SHREVE, F., The rôle of winter temperature in determining the distribution of plants. Amer. Jour. Bot. 1:193–202. 1914.

in the past, of considering a degree in one part of the temperature scale the equivalent of a degree at any other part of the scale, as is done in the use of the annual mean temperature or even in totaling the degrees of temperature for the growing season. Although more attention has been given to the temperature phenomena of the growing season, he believes that the temperature phases of the frost season are perhaps of equal importance, especially in determining the distributional limits of some subtropical plants. He has already shown, as noted in this journal,[25] that the temperature conditions in mountains is often complicated by cold air drainage, but it would appear that in such situations winter temperatures are effective in determining the vertical limits of many species. Observations show that the number of consecutive hours of freezing temperature is the factor most closely corresponding in its distribution with the limitation of the species concerned. This would harmonize with SHREVE'S[26] experiments with the giant cactus, which show that the number of hours of exposure to temperature below freezing determines its death, without regard (within certain limits) to the absolute minimum reached. Thus *Cereus giganteus* is unable to resist freezing of over 19–22 hours duration, while other related Arizona species withstood periods up to 66 hours, and *Opuntia missouriensis* has been known to survive 375 consecutive hours of freezing temperature in Montana. The importance is thus emphasized of applying the exact quantitative methods of physiological work to plant geography in order to place its generalizations upon a secure logical basis.

In this connection it is interesting to note the method described by McDOUGAL[27] of applying to the summation of temperature in hour-degree units for a given time a factor expressing the rate of growth of a particular species, in order to give the relative values of such temperature exposures.—GEO. D. FULLER.

Production of alcohol by higher plants.—MINENKOW,[28] investigating the question of alcohol production by higher plants fully aerated, and the influence of osmotic pressure and temperature on the process, finds that well aerated, sterile solutions of glucose (15.8 per cent), sodium sulphate (6–7.8 per cent), and di-potassium hydrogen phosphate (7.25 per cent) retard germination of *Vicia Faba* and favor alcoholic production so that the ratio of carbon dioxide to alcohol approached nearer the value observed for alcoholic fermentation than with seeds germinating in water. Growth was retarded by these

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[25] BOT. GAZ. **55**:263. 1913.

[26] SHREVE, F., The influence of low temperature on the distribution of the giant cactus. Plant World **14**:136–146. 1911.

[27] McDOUGAL, D. T., The auxo-thermal integration of climatic complexes. Amer. Jour. Bot. **1**:186–193. 1914.

[28] MINENKOW, A. R., Die alkoholische Gärung höherer Pflanzen. Biochem. Zeitschr. **66**:467–485. 1914.